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When Linder Meets Hirschman:
Inter-Industry Linkages and Global Value Chains in Business Services

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ABSTRACT

This paper looks at the determinants of a country's participation in business services (BS) Global Value Chains (GVCs). BS GVCs are comparatively less explored than traditional manufacturing ones, and there is a gap in the literature on the relative positions of countries in BS GVCs and the opportunities they might open for development. This paper puts forward and finds empirical support to the conjecture that the *domestic structure of backward and forward linkages à la Hirschman*, alongside the *domestic representative demand for BS à la Linder,* are of high importance. The results, based on the World Input Output Database, suggest that the presence of strong domestic backward-linked industries to BS makes an emerging country more likely to create domestic value within BS GVC. Our findings contribute to the debate on a "premature de-industrialisation" in emerging countries and on the relationship between levels of development and engagement in BS GVCs.

KEYWORDS: BUSINESS SERVICES; GLOBAL VALUE CHAINS; HIRSCHMAN LINKAGES; DEVELOPMENT.

JEL CODES: F63; L16; L80; O14.

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1. Introduction

It is often argued that the international fragmentation of production offers developing countries the opportunity to 'fast-track' the process of industrialisation. Indeed, with the emergence of global value chains (GVCs), emerging countries can now specialise in particular tasks along the value chain rather than having to set-up entire processes of production from scratch (see Kaplinsky 2013; De Backer and Miroudot 2013; Timmer et al. 2014; and Baldwin & López-Gonzalez 2015). Richard Baldwin (Baldwin 2011) has defined this phenomenon as globalisation's 'second unbundling', transforming the terms of international competition and shifting the barycentre of the world's global headquarters and peripheries.

The emerging empirical studies on whether GVCs provide new development opportunities (Gereffi 2015) are in general limited to participation in manufacturing activities. However, in the context of the rising service content of exports, and the 'servicification' of manufacturing (Kommerskollegium 2012; Pilat and Wölfl 2005; Pilat et al. 2008; Lanz and Maurer 2015; Miroudot and Cadestin, 2017), it is relevant to ask whether domestic value creation within service GVCs responds to the same drivers and therefore presents similar opportunities for emerging countries.

The question is all the more relevant in the case of business services (BS)[4], the most dynamic branch of services, and one which plays an essential role in the creation and diffusion of new technologies and non-technological modes of innovation (Guerrieri and Meliciani 2005; Gallouj and Savona 2008; Ciarli, Meliciani, and Savona 2012; Meliciani and Savona, 2014).

The emerging country context is especially interesting if participation in BS GVCs offers an additional channel for technology transfer to occur, and provides opportunities for domestic technological upgrading. Scholars looking at the link between global trade and local upgrading have rarely explicitly focused on BS GVC links (Fu, Pietrobelli, and Soete 2011; Pietrobelli and Rabellotti 2011). A few recent contributions, based on qualitative evidence on specific country cases, suggest that participation in BS GVC can open up new opportunities for catching up in emerging countries (Blinder 2006; Gereffi and Fernandez-Stark 2010; Hernández et al. 2014). Similarly, only a few, recent, quantitative contributions (Banga, 2014; Francois et al., 2015; and Miroudot and Cadestin, 2017) have looked at the new trends of services and BS tradability in the context of GVCs.

[4] BS include ICT-related services (ISIC code 72), Research & Development (73) and all intermediate services such as engineering, technical consultancy, legal aid and other business services (74). See Table A4 in the Appendix for a detailed list of sectors.

Some of this evidence shows that the relative position of developed and emerging countries in terms of services value added content of export is quite different, with emerging countries having comparatively less service content in trade (Francois et al., 2015) and more foreign services value added embodied in (manufacturing) exports (see Lopez-Gonzalez 2016 for the case of Southeast Asia). What drives countries towards participation in BS GVCs remains relative unexplored and yet relevant for trade and development policy.

This paper aims to identify the main determinants of participation in BS GVCs in both developed and emerging countries.[5] Our main conjecture is that, differently from manufacturing GVCs, it is more difficult for emerging countries to create domestic value in BS GVCs by mainly relying on foreign demand from headquarter economies. This conjecture is grounded in empirical evidence, showing that BS tend to locate closely to the sectors representing their pool of demand, most often manufacturing sectors (Meliciani and Savona 2014), and contribute to knowledge accumulation and leveraging for the rest of the economy (for a review, see Ciarli, Meliciani, and Savona 2012; Gallouj and Savona 2008). We therefore expect that countries where the lack of core domestic intermediate demand for BS is particularly salient, such as emerging countries, may find it more difficult to export domestic value added in BS relative to those that are able to exploit these linkages.

Due to the on-going process of servicification of manufacturing – and international fragmentation of production processes – we expect the *specific domestic structure of inter-sectoral linkages between BS and other industries* (particularly manufacturing) to be one of the key determinants of a country's participation in BS GVCs. As a consequence, in the absence of a strong domestic base of backward-linked industries to BS it is more difficult for emerging countries to engage in forward participation in BS GVCs.

While we do not attempt to formalise our conjecture in a formal theoretical model, we show that this is grounded in the observation of recent empirical evidence on trends of GVCs (illustrated in Section 2.1 and 2.2 below). Further, our conjecture is theoretically embedded in a careful revisitation of classical contributions to development economics (Hirschman 1958) and trade theory (Burenstam Linder 1961) often neglected in these circles (illustrated in Section 2.3).

[5] There is a flourishing literature on the determinants of GVC participation in developing countries (see Kowalski et al. 2015 and Taglione and Wrinkler, 2016).

We formulate and empirically test *a joint Hirschman-Linder hypothesis* as we expect that both domestic inter-sectoral linkages (Hirschman) and the presence of a "*representative domestic* (derived) *demand*" for BS (Linder) affect participation in BS GVCs.[6]

We test our hypothesis using the World Input Output Database, which we draw upon to construct indicators of forward participation in BS GVCs and a range of proxy measures for domestic and international linkages. In the econometric specification, we consider that a Hirschman-Linder effect might also occur in close trade partners. Hirschman linkages and Linder effect favoring participation in BS GVCs of trade partners' countries might also affect a representative country's participation in BS GVCs. We expect this effect to be positive or negative depending on whether Hirschman-Linder linkages in trade partners act as an (additional) international derived demand for BS or, rather, when a competition effect dominates. In this latter case, Hirschman-Linder linkages in trade partners displace participation in BS GVCs in the representative country.

Our results suggest that the determinants of participation in BS GVCs partly differ from those that determine engagement in manufacturing GVCs. The domestic industrial structure, particularly if intensive in industries that are backward-linked to BS, plays a central role in explaining participation in BS GVCs. However, differently from participation in manufacturing GVC, proximity to countries involved in BS GVCs does not help emerging countries to participate in global value chains. This casts doubt on BS GVCs presenting the same type of opportunities for emerging countries as they do for developed countries.

We attempt reflections on the implications of our results in terms of policies for development and suggest some caution when considering unconditional participation in BS GVCs as a new development pathway in the absence of sectoral and technological upgrading linked to the presence of domestic backward-linked sectors, particularly a domestic manufacturing base. We therefore offer, albeit from a different theoretical perspective, empirical ground to some of the concerns of "premature de-industrialisation" put forward by development scholars (Rodrik 2015). Our findings also support the conjectures recently put forward by Lee et al., (2017), Lee and Malerba (2017), Baldwin (2013) and Lopez-Gonzalez and Holmes (2011), who have looked at the relationship between levels of development and participation in GVCs. According to these, countries tend to predominantly rely on foreign inputs at early stages of development (high intensity of backward

[6] We articulate the Hirschman-Linder hypothesis more at length in Section 2.3. Interestingly, albeit from a very different perspective, our conjecture resonates with what has most recently been put forward by Baldwin and Venables (2015) and in line with what Poncet and Starosta de Waldemar (2013) find.

participation) but predominantly contribute with domestic value added to foreign exports at later stages of development (high intensity of forward participation) [7].

The remainder of the paper is structured as follows: the next section reviews the relevant theoretical and empirical literature on BS GVCs. We lay out our main conjecture and argument in Section 3. Section 4 details the empirical strategy: the indicators that we construct on the basis of the WIOD (World Input Output Database) with respect to extant measurements of value chains in the literature and the econometric strategy. We then discuss the econometric results in Section 5 and conclude in Section 6.

2. Trends of GVC in services

A defining feature of global trade today is the international fragmentation of production, which has led to more trade of intermediates through the emergence of GVCs. These have been the object of an increasing amount of theoretical and empirical interest and a flourishing number of contributions on methods to measure participation in GVCs (see among others, Grossman and Rossi-Hansberg, 2006; Costinot, Vogel, and Wang 2013; Timmer et al., 2013; OECD 2013, Kowalski et al. 2015; Koopman et al., 2014).

Baldwin (2011) first put forward the idea of globalization's "second unbundling", which started after 1985 and was driven by a reduction in *Information and Communication Technology* (ICT) costs, resulting in the unpacking of factories and leading to widespread *offshoring* and growing trade in intermediate products. This second unbundling shifted the nature of international competition towards *stages of production* rather than *products* and led to the spatial redistribution of global economic activity between 'headquarter'[8] and 'factory' economies. The latter are mainly emerging countries, specializing in the lower-tech (usually low-skilled) phases of manufacturing, while the high-tech (usually high-skilled) segments tend to remain within the boundaries of the headquarter economy.

[7] Differently from these papers the aim of our analysis is not to study pathways that emerging and developing countries take to develop domestic capacity and participate in GVCs, such as those outlined in the in-out-in conjecture of Lee et al. (2017). Rather, we focus on countries that have already reached a certain level of development (emerging) and we look at the importance of domestic linkages to create domestic value added in business services exports. Identifying what countries should do first, or what type of policy would be most helpful at different levels of development, is an important issue which we hope to turn to in future work.

[8] The term was coined by Baldwin (2006) and then used in Baldwin (2011) and Baldwin and Lopez-Gonzalez, 2015). In Baldwin and Lopez-Gonzalez (2015), headquarter economies are identified as those that have strong forward participation links with emerging and developing nations located in close proximity

Participation in GVCs has been claimed to be a unique opportunity for emerging and developing countries, allowing these to industrialise in a fraction of the time that developed countries took to take off (Baldwin 2011)[9].

However, Baldwin's (2011) first and second unbundlings refer mainly to manufacturing value chains. But there is an emerging literature highlighting the growing 'servicification' of manufacturing, and the growing service content of exports (Pilat 2005; Pilat et al. 2008; Lanz and Maurer 2015; Gereffi and Fernandez-Stark 2010; Hernández, et al. 2014; OECD, 2013, Kommerskollegium 2012). Evidence shows, for example, that Europe's value added that is used by China to produce exports comes predominantly from the service sectors which China uses to engage in the low-skill manufacturing elements of the value chain (Koopman et al. 2008).

Two other key findings are worth highlighting. The first is the relative importance of business services in value added terms over gross exports (Figure A1). In 2011, gross BS exports represented nearly 5% of total gross exports (Figure A1a), but in value added terms, when considering BS embodied in other exported products, the importance of BS more than doubles to 11% of gross exports (Figure A1b). In terms of both gross exports and the value added embodied in gross exports, the importance of BS has increased (by around 1 percentage point), unlike that of manufacturing which has declined by around 8 percentage points in both gross exports and value added terms. This is in line with the evidence shown by Banga (2014), Francois et al. (2015) and Miroudot and Cadestin (2017) suggesting that trade specialisation in BS might need to be re-assessed. As put by Koopman et al. (2014, p. 461):

"(..) with gross trade data, the business services sector is a revealed comparative advantage sector for India. In contrast, if one uses our estimated domestic value added in exports instead, the same sector becomes a revealed comparative disadvantage sector for India in 2004. The principal reason for this is how the indirect exports of business services are counted in high income countries. Consider Germany. Most of its manufacturing exports embed German domestic business services. In comparison, most of Indian goods exports use comparatively little Indian business services. Once indirect exports of domestic business services are taken into account, Indian's business services exports become much less impressive relative to Germany and many other developed countries"

[9] In terms of gains for developing countries, as Baldwin (2011, p.33) puts it:"*The 2nd unbundling made industrialization less meaningful. Before the 2nd unbundling a nation had to have a deep and wide industrial base before it could export, e.g. car engines. Exporting engines was a sign of victory. Now it is a sign that the nation is located in a particular segment of an international value chain*". This view, however, abstracts from the risk of a specialisation trap in the low-end segments of the value chain and from considerations related to the conditions that ensure successful upgrading.

The second is the uneven distribution, or the concentration, of global suppliers of intermediate business services (Figure 1).[10] Indeed, 'headquarters economies'[11] such as the US, the United Kingdom and Germany provide over one third of global BS value added in exports (18%, 9% and 8% respectively). By contrast, developing countries such as China and India tend to be net recipients of BS value added. Comparing this table to that of manufacturing in Baldwin and Lopez-Gonzalez (2015) shows that, globally, BS value added in exports tends to be more concentrated than manufacturing value added in exports.

(Figure 1 about here)

Overall, emerging countries have been the destination of an increasing volume of standardised Information Technology Outsourcing (ITO), due to a combination of decreasing Information Technology (IT) costs, increasing opportunities for standardisation of typical IT functions, and a very recent drive to look for 'talents' across the whole world, that for the first time does not exclude the participation of emerging countries (Lewin, Massini, and Peeters 2009).

The top segments of offshore services are Business Process Outsourcing (BPO) and Knowledge Process Outsourcing (KPO), which are more intensive in high-skilled human capital and knowledge and typically remain within headquarter economies. However, it has been argued that in most recent years an increasing trade share of these high-skilled activities have involved Latin American countries, the Philippines and Malaysia. The tone of the emerging discourse seems to depict a rosy picture, in terms of developmental opportunities for periphery countries to join business service GVCs, and the role of industrial policy to favour this process (Gereffi and Fernandez-Stark 2010). However, the reflection on service GVCs is still at its embryonic stage, with much empirical evidence still limited to qualitative, single industry case studies, which, although highly informative, lack generalisability, calling for some cautiousness.

To summarise, while the literature has looked mainly at GVCs in manufacturing and the relative position of developed and emerging countries within these (see for instance Baldwin, 2016), based on the traditional view on technology transfer embodied in tangible intermediates, GVCs in business services are in general much less explored, despite a recent surge in interest (Francois et al., 2015; Koopman et al., 2014; Miroudot and Cadestin, 2017).

[10] The entries in Figure 1 mark the value of the row nations sales of BS to the column nation divided by global trade in BS value added in exports.

[11] The term was coined by Baldwin (2006) and then used in Baldwin (2011) and Baldwin and Lopez-Gonzalez (2015). In Baldwin and Lopez-Gonzalez (2015), headquarter economies are identified as those that have strong forward participation links with emerging and developing nations located in close proximity.

A relevant question within the growing GVC literature is whether participation in manufacturing and business services GVCs responds to similar determinants and whether they can open up new opportunities for industrial development. To address these questions, we argue that it is important to understand if emerging countries are able to create domestic value in BS GVCs without an adequate domestic capacity, where this latter, we argue, is linked to the presence of domestic (backward) linked industries, such as the manufacturing sectors.

3. When Linder meets Hirschman: A reappraisal of business services GVCs

The study of the effects of structural change on economic performance of countries has traditionally brought about concerns about de-industrialization processes and the erosion of capital accumulation in advanced countries[12]. In some cases, positive expectations on knowledge accumulation and leveraging for the rest of the economy, intrinsic in some business services[13] and the widespread diffusion of ICTs have counter-balanced this view (for a review, see Ciarli, Meliciani, and Savona 2012; Gallouj and Savona 2008; Meliciani and Savona 2014). The empirical evidence on the emergence of Knowledge Intensive Business Services (KIBS) has often sided with this narrative[14].

When it comes to patterns of structural change in emerging countries, involving shifts from agriculture to low-tech industries and services, the empirical evidence is more mixed and controversial (Dasgupta and Singh 2005; Dasgupta and Singh 2006; Bah 2011), and rarely takes into account the global dimensions of structural changes, with notable exceptions (McMillan, Rodrik, and Verduzco-Gallo 2014; Rodrik 2015). Despite this, the theoretical and empirical debates within the trade and GVCs literatures seem to suggest that structural changes toward business services in developing countries could be desirable, and eased by joining business service GVCs.

Borrowing from Baldwin (2011), it can be argued that the increasing involvement of services in GVCs is a sort of 'third unbundling', equivalent in importance to the processes of tertiarisation that followed industrialisation in developed countries, occurring now on a global scale, albeit at different levels of aggregate income (McMillan, Rodrik, and Verduzco-Gallo 2014; Rodrik 2015). For the purpose of identifying the determinants of the emergence of service GVCs, we put forward four

[12]A seminal contribution on the topic remains that by Kaldor (1966), followed by Baumol (1967) and Fuchs (1968).
[13]Classical contributions to the opposite stand – i.e. the optimism toward the progress and 'third industrial revolution' are (Fourastié 1949; Bell 2008).
[14]More specifically, concerns about tertiarisation have been *cyclical*: a further evidence of this is the very recent "re-assessment" of the benefits of industry - most likely due to the second public outrage following the tarnish consequences of the latest global financial crisis - as reported in the EC 2013 Competitiveness Report "Towards Knowledge-Driven Re-industrialisation" or the Juncker Plan in Europe aiming at an "industrial *renaissance"* of Europe.

questions and attempt to provide a testable framework that can answer them:

1. What are the determinants of countries' participation in business service GVCs and are they different from those relevant for participation in manufacturing GVCs?
2. Are the determinants of participation in business services GVCs different in developed and emerging countries?
3. Relatedly, does proximity to large headquarter economies matter for participation in BS GVCs? Alternatively, to what extent do countries need to develop their own capacity internally - in the form of domestic presence in high BS user sectors?
4. What are the implications in terms of industrial policy for development?

While we do not attempt to tackle these questions in a formal theoretical model, we articulate the intuition that, in the absence of a strong domestic presence of backward-linked industries to BS (industries demanding BS as intermediates), emerging countries will find it more difficult to create domestic value within BS GVCs.

Our conjecture is based on the empirical evidence on trends in GVCs illustrated above and is theoretically embedded in a careful revisitation of classical contributions to development economics (Hirschman 1958) and trade theory (Burenstam Linder 1961), often neglected in these circles (Lundhal 2006).

In a seminal text on economic development, Hirschman (1958) identified the structure of sectoral intermediate linkages within regional economies as the main determinant of specialisation and growth polarisation. According to Hirschman, there are different types of externalities, depending on whether activities are related to one another by backward or forward inducement mechanisms, i.e. whether certain sectors, by demanding inputs, induce the growth of supplier industries (input-provision or backward linkage effect) or, rather, by supplying output induce the growth of client industries (output-provision or forward linkage effect)[15].

Hirschman took a remarkably original stand with respect to the mainstream growth theory of the time based on factor endowments. Sectoral specialisation and structural change had hitherto rarely been considered of much relevance in explaining growth polarisation across local and national

[15] "The input-provision, derived demand, or backward linkage effects, i.e. every non primary economic activity, will induce attempts to supply through domestic production the inputs needed in that activity. The output-utilization or forward linkage effects, i.e., every activity that does not by its nature cater exclusively to final demands, will induce attempts to utilize its outputs as inputs in some new activities" (Hirschman, 1958).

economies[16]. The role of linkages in Hirschman's work serves the purpose of *creating new sectors* by way of scalable intermediate demand, and therefore represents a useful device to explain structural change of the sectoral composition of economies. Hirschman's work, however, remained relatively silent on the conditions and specific mechanisms by which intermediate demand is translated into the creation of new supplier sectors[17], and how this, in turn, leads to upgrading. Recently, the role of structural transformation is being increasingly brought back in the development debate (Lin 2012; Stiglitz, Lin, and Monga 2013).

The work of Linder (Burenstam Linder 1961) also emerged as a particularly radical stand against mainstream trade theory following the Heckscher-Ohlin-Samuelson model. The latter explained foreign trade on the basis of cross-country differences in factor endowments, such that trade specialisation would follow endowment abundance so that capital-intensive countries would export capital-intensive goods, while countries with a higher relative endowment of labour would specialise in and trade labour-intensive goods. In this context, Linder put forward what is now known as the *Linder Thesis*.

According to Linder (1961), the Heckscher-Ohlin model was able to explain trade in raw materials, but less so the patterns of trade in manufactured goods between similar nations (in terms of their level of development). Manufacturing trade depended on whether a country reached a certain level of domestic *representative demand*. This benchmark level of domestic demand, in turn, provided the necessary information from purchasers to producers, which eventually allowed them to face competition in foreign markets. Therefore, countries with a similar structure of final demand – owing, for instance, to similar levels of per capita income – tended to have similar structures of trade specialisation. This then helped explain the prevalence of intra-industry trade between similar economies.

In his 1961 "Essay on Trade and Transformation" Linder mentions (p. 94): "*The more similar the demand structure of two countries, the more intensive, potentially, is the trade between these two countries";* and that (p. 94) "*similarity of average income levels could be used as an index of similarity of demand structure"*. Indeed, as it emerges clearly in his book, the core and novelty of his thesis as to what affects trade is (1) the emergence of a domestic need; (2) the development of

[16] These intuitions have on some occasions been taken up and operationalized in the literature (Jones 1976); see also, more recently, Hausmann, Klinger, and Lawrence (2008), although it is out of the scope of this paper to go more in depth into these.
[17] We owe to Martin Bell reflections on structural change within Hirschman's work.

domestic capabilities to satisfy it; and (3) as a consequence, the achievement of a critical mass of 'representative domestic demand' that eventually becomes a comparative advantage for trade.[18]

Here we adopt and re-propose Linder's classical notion of a '*representative domestic demand*' with a view of including not only its original meaning – that is the domestic structure of (final) demand associated to the specific level of development of a country – but also, and in the same vein, that such specific level of development affects the structure of derived demand for BS coming from different sectors[19].

We therefore formulate and empirically test *a joint Hirschman-Linder hypothesis* as we expect that both domestic inter-sectoral linkages (Hirschman) and the presence of a "*representative domestic* (derived) *demand*" for BS (Linder) affect participation in BS GVCs. Our implicit conjecture is that countries that develop a critical mass of domestic activities linked to BS are more likely to develop a comparative advantage in BS GVCs. Moreover, given the 'servicification' of manufacturing (Kommerskollegium 2012; Pilat and Wölfl 2005; Pilat et al. 2008; Lanz and Maurer 2015, Miroudot and Cadestin 2017), we suggest a special role to be played by the presence of a domestic manufacturing base for BS domestic value added in exports through strong manufacturing-BS inter-sectoral linkages.

4. Empirical strategy

The empirical strategy aims to identify the determinants of participation in BS GVCs. It operationalizes a joint Hirschman-Linder hypothesis and combines this with traditional cost and factor endowment measures. Alongside these, we take into account three sets of new determinants affecting participation in BS GVCs:

[18] Interestingly, in the same essay Linder (1961) states (p. 90): "We have now given three reasons which lend support to the assertion that a particular good will not be produced at a comparative advantage unless there is a domestic market for the good. We have argued (1) that it is unlikely that an entrepreneur will ever think of satisfying a need that does not exist at home; (2) that, even if this alien need was seen, the basically correct product to fill it might not be conceived of; and (3) that, even if the basically correct product was conceived of, it is still improbable that the product could be finally adapted to unfamiliar conditions without prohibitive costs being incurred. In all, what our arguments amount to is the proposition that production functions are not identical in all countries, but that the production functions of goods demanded at home are the relatively most advantageous ones. The necessity of "the support of the home market" is probably stressed by active businessmen as a reflection of the importance of relationships emphasized here."

[19] It is worth highlighting that the reference to Linder in our context slightly departs from what is generally known as the *Linder Thesis* in trade theory, i.e. the proposition that countries with similar levels of per capita GDP should trade more. Rather, we refer to his original notion of representative domestic demand for a particular good as a determinant of trade in that good.

(i) The *domestic Hirschman-Linder linkage.* This identifies the domestic structure of inter-sectoral linkages and the level of derived demand for BS in the representative country. We expect this variable to have a positive impact on our outcome variable, BS GVCs.

(ii) The *domestic Hirschman-Linder linkage of trade partners.* This identifies the domestic structure of inter-sectoral linkages and the level of derived demand for BS in distance-weighted trade partners. This variable can have a positive or negative effect, depending on whether domestic Hirschman-Linder linkages in trade partners act as an (additional) international derived demand for BS for the representative country or, rather, if a competition effect dominates and displaces participation in BS GVCs.

(iii) The spillovers, or GVC linkage, with trade partners. Capturing the participation in BS GVCs in distance-weighted trade partners, which, in turn, might have a positive or negative effect depending on whether geographical closeness and partner country participation in BS GVCs entails positive or negative spillovers.

We also control for more traditional cost and endowments factors, such as skills, wages, technology, as well as for a set of BS-specific factors, such as trade agreements in services and telecommunication infrastructure. We consider differences across sectors (BS and manufacturing) and across countries (developed and emerging).

4.1 Data

We use the World Input-Output Database (WIOD - November 2013 release), which covers 40 economies (including all EU-27 countries as well as Australia, Brazil, Canada, China, India, Indonesia, Japan, Korea, Mexico, the Russian Federation, Chinese Taipei, Turkey and the US) and a rest of the world aggregate grouping across 35 sectors (20 of which are services, 11 manufacturing, and 4 primary sectors) and 15 years (annually from 1995 to 2009). Tables A4 and A5 in the Appendix respectively list the sectors and countries included in our analysis. The database has two key components: i) an annual inter-country input-output (ICIO) table; and ii) an accompanying set of Socio Economic Accounts (SEAs).[20]

The ICIO tables lend themselves to the calculation of indicators that capture the extent and nature of GVC participation across different sectors (see Timmer et al, 2013). The SEAs then give us valuable information on the wage bills or indeed the hours worked by labour of different skills within countries, which we exploit and combine with indicators of GVC participation to test our hypotheses. As

[20]See (Los, Timmer, and de Vries 2012). The ICIO has recently been extended to incorporate data till 2011 but the SEAs only go as far as 2009.

mentioned, comparative analysis is undertaken across countries at different stages of development to identify whether there are significant differences between developed and emerging economies (for a list of emerging economies in the sample, see table A5).[21]

Finally, we use the Panel Dataset for Cross-Country Analyses of National Systems, Growth and Development (CANA) (Castellacci and Natera 2011) to construct proxies of countries' technology endowment and the DESTA database (Dür et al., 2014) to identify the service related trade policy environment.

We cover the period 1995 to 2009 only due to data limitations. Although ICIO tables are now available from 2000 to 2014 (whether from the WIOD or the OECD-WTO TiVA database) the SEA containing information on wages and hours worked for workers of different skills, important control variables, are only available till 2009.

4.2 Variables

Our choice of indicators is informed by the mushrooming literature on GVCs based on ICIO models. We exploit different indicators based on these models to construct both dependent and independent variables paying particular heed to avoiding mechanical associations between these in the estimations.

Engagement in Business Service GVCs

Our interest lies in the determinants of GVC participation in business services. The literature on GVCs typically employs two measures of participation. These are the backward and the forward participation indicators, which are respectively the importing and exporting elements of GVCs (see Figure A2). The figure illustrates how gross exports can be decomposed into many different constituent elements. At their most basic, gross exports are composed of domestic and foreign value added which can themselves be further decomposed using Input-Output tables. For example, the domestic value added that is embodied in exports can serve to produce final goods and services (element (1) in figure A2) or it can be used to produce intermediates which are then used domestically (2) or exported (3+4).

Forward participation refers to the domestic value added in foreign exports (3+4) while backward participation refers to the foreign value added in domestic exports (5+6). Importantly, backward and

[21] Countries are defined as emerging following the IMF definition in 2009 (the last year in the sample, see https://www.imf.org/external/pubs/ft/weo/2009/02/weodata/groups.htm).

forward participation are related: the backward participation of Country A with respect to the world is the sum of the forward participation of all other countries with respect to Country A.[22] However, their determinants vary widely (see Kowalski et al, 2015).

Much work on GVCs to date uses these gross export decompositions to calculate GVC participation indicators (see for example OECD, 2013 and Koopman et. al, 2014). The focus on backward or forward participation indicators depends, among other things, on the specific research question and the aimed contribution.[23] In this paper, we are interested in explaining countries' capability to export (directly and indirectly) BS value added (the exporting element of GVCs). We, therefore, focus on participation on the seller side, proxied by BS domestic value added in foreign exports – a measure of forward GVC participation in BS[24]. We also report robustness checks using as dependent variable BS domestic value added in total exports (elements 1 to 4 in Figure A2) which proxies the overall capability of the domestic country to create value (Table A7)[25]. The domestic business service value added in foreign exports (DBSVAE) is identified from an underlying matrix of value added in exports (VAE) calculated from the WIOD database as:

$$VAE = V'[I - A]^{-1}EXP \quad (1)$$

Where:

V' is a *ni x ni* matrix with *n* countries (n= {1,2… 41}) and *i* sectors of activity (i= {1,2… 35}). It is populated with elements $v_{ni} = {}^{V_{ni}}/_{X_{ni}}$ capturing the direct value added (V) share of sector *i* in country *n* in the output (X) of the industry across the diagonal (with zeros elsewhere).

[22] Globally, backward and forward participation will be the same since what is exported within GVCs has to be equal to what is imported within GVCs.

[23] Forward and backward participation are also interrelated. Indeed, the backward participation of Country A is the sum of the forward participation of all other countries with country A.

[24] A variant of this indicator decomposes value added, similarly across countries and sectors, but according to final demand (Los, Timmer, and de Vries 2012; Erumban et al. 2011). This tracks not just the value added traded in the production of exports, but also that used to satisfy domestic and international final demand. Both indicators involve similar calculation techniques but the former is solely concerned with exporting activities whereas the latter considers the origin of value added in GDP. The difference is important because domestic final demand and gross export vectors differ.

[25] BS domestic value added in total exports captures the ability of a country to add BS domestic value to exports while BS domestic value added in *foreign* exports, which represents a subset of the former indicator, relates only to the domestic value added that serves as input into other countries exports. Both measures are suited to test the Hirschman-Linder Hypothesis but the second indicator is more focused on the GVC elements. Indeed, in BS on average around 30% of domestic value added in exports is composed by forward participation sales. But there is strong variance. For instance, in India 26% of the BS value added in exports is forward participation, in the UK the share is closer to 31%. Data for each country are available on request.

The $[I-A]^{-1}$ is the Leontief inverse matrix that captures the inter-linkages within and between sectors across all countries. It is obtained from inverting the product of the subtraction of the technical coefficient matrix (A) with elements $a_{ni} = {}^{I_{ni,j}}/_{X_{ni}}$ from the identity matrix (I).

Finally, EXP represents a diagonalised vector of gross exports. The resulting VAE matrix has an *ni x cj* dimension *w*here *n* refers to the selling country and *c* to the buying country (n= c{1,2… 41}) (see Table A5); *i* to the selling sector and *j* to the buying sector (i=j {1,2… 35}) (see Table A4). It decomposes the origin of value added embodied in gross exports.

The domestic business service element of foreign exports (DBSVAE) is identified from this VAE matrix as the row corresponding to BS (where BS is defined as ISIC sectors 71-74 see Table A4):

$$DBSVAE_n = \sum_j VAE_{n,c,i,j} if\ n \neq c\ and\ i = BS \quad (2)$$

It captures the domestic business service value added that is exported by foreign countries. A manufacturing equivalent of this indicator, DmanufVAE, is also calculated, it uses the same VAE matrix but only takes the sum of the non-domestic rows of the manufacturing sector (see Appendix).

Domestic Hirschman-Linder Linkages

Our independent variables aim to capture different domestic linkages arising from the intermediate and final demand for business services. One key concern in identifying such linkages is avoiding mechanical associations (spurious correlations) between the dependent and independent variables used. The domestic Hirschman-Linder linkage should capture the strength of the business service linkages with respect to domestic activity in a way that does not introduce mechanical associations with the indicator of engagement in business service GVCs.[26] These are avoided by calculating a new set of indicators that focus solely on domestic final demand (following a similar method to that in Los et al. (2012) but removing foreign final demand). The Hirschman-Linder linkage variables therefore capture domestic derived demand linkages net of those that are related to trading activities. The difference between these indicators and the dependent variable lies in the use of final domestic demand rather than gross exports in the Leontief system (i.e. the export vector EXP is now a vector of domestic final demand, DFD). [27]

[26] Identifying the linkage by reading off the IO relations would not work since the linkages serve the purpose of producing for final domestic and foreign demand.
[27] Domestic final demand includes domestic final consumption by households or government as well as investment, i.e. gross fixed capital formation.

Two Hirschman-Linder linkage indicators are calculated. Domestic linkages for business services with respect to all activities in the economy (bsDDEM), and with respect to manufacturing activities only (bsDDEMmanuf). In this instance *manuf* is defined as ISIC sectors 15-37 see Table A4:

$$VADFD = V'[I - A]^{-1}DFD \quad (3)$$

$$bsDDEM_n = \sum_j VAFD_{n,c,i,j} if\ n = c\ and\ i = BS \quad (4)$$

$$bsDDEMmanuf_n = \sum_j VAFD_{n,c,i,j} if\ n = c, i = BS\ and\ j = manuf \quad (5)$$

bsDDEM is the row corresponding to BS in the VADFD matrix and includes the use of BS across all sectors in the economy capturing both direct and indirect contributions of this sector to domestic final demand. bsDDEMmanuf is the sum of the domestic business services row over the domestic manufacturing activities in the VADFD matrix. It therefore captures the domestic business services sector value added used by domestic manufacturing sectors to satisfy domestic final demand. This second indicator is used to test whether linkages between BS and manufacturing are particularly relevant. Similar indicators are also calculated for the manufacturing sector (see Appendix).

Domestic Hirschman-Linder linkages of distance weighted trade partners

The extent to which partner countries are exploiting their own domestic Hirschman-Linder linkages might also have an effect on a representative country's participation in BS GVCs if, for example, these linkages displace or complement country participation in BS GVCs. To account for this we identify the domestic Hirschman-Linder linkages of distance weighted trade partners for both business services, bsDDEM_par (Equation 6), and manufacturing, manufDDEM_par (see Appendix)[28]:

$$\text{bsDDEM\_par}_n = \sum_n bsDDEM_n \cdot \frac{distance_{n,c}}{\sum_n distance_{n,c}} if\ n \neq c \quad (6)$$

Potential international spillover or GVC linkages

The emergence of GVCs offers countries the possibility of relying on foreign linkages in order to enhance their economic activity. To capture the potential for such spillover effects arising from GVCs we take the mirror image of our dependent variable for partner countries. That is, the DBSVAE_par, the domestic business service value added in foreign exports, but of trade partners, weighted by

[28] Distance variables are obtained from the CEPII gravity database see Mayer and Zignago (2011). It uses geodesic distances calculated following the great circle formula using latitudes and longitudes of most important cities or agglomerations (in terms of the population) and accounting for internal distances using population weights.

distance to the representative country (Equation 7). A similar indicator is calculated for the manufacturing activities of partner countries - DmanufVAE_par (see Appendix). The indicators are a measure of how other countries engage in GVCs in both business services and manufacturing and are therefore a proxy for the potential to develop foreign GVC linkages.

$$DBSVAE\_par_n = \sum_n (DBSVAE_n).\frac{distance_{n,c}}{\sum_n distance_{n,c}} \; if \; n \neq c \qquad (7)$$

Other control variables

We also control for more traditional cost and endowments factors, such as skills, wages, technology, as well as for a set of BS-specific factors, such as trade agreement in services and telecommunication infrastructure. As a proxy for skills, we use the share of direct value added attributed to high-skill labour obtained from the SEAs and the share of public spending education on GDP obtained from Castellacci and Natera (2011). As a proxy for cost we use the hourly wage of high-skilled workers[29], which we compute from the SEAs of the WIOD by dividing the aggregate wage bill associated to high-skilled labour by the amount of hours worked by high-skill workers. We also control for capital per worker taken also from the SEAs. Technology is proxied by R&D over GDP and communication infrastructure by Internet users per 100 people as taken from Castellacci and Natera (2011)[30]. Finally, as a policy variable more specific to BS, we measure the number of service provisions in a country's trade agreements (from the DESTA database).

Tables A1, A2 and A3 in the Appendix describe the different variables used, report some descriptive statistics and the correlation matrix among explanatory variables.

One important caveat of the analysis relates to the level of aggregation. As reported in Table A4, the WIOD database captures only 35 sectors, within these there can be wide variations in the composition of value added and therefore the nature of participation in GVCs. For instance, the business services sector includes activities such as renting of machinery, research and development as well as data processing, legal services, advertising or packaging activities. Differences in the composition of countries' BS are therefore not appropriately captured. This also affects the analysis in the manufacturing sectors where specialisation within say, motor vehicles can also not differentiate between selling motor bikes versus selling luxury cars.

[29] Since not all business services are knowledge intensive, we also tried the hourly wage of medium and low skilled workers but these were never significant.

[30] As a proxy for technology, we have also tried trademarks but they were not significant. We have also tried a number of other proxies for telecommunication infrastructure (all those available for our country sample) such as mobile phone subscribers, telephone lines and telecommunication expenditure but neither of those was significant.

4.3 Pattern of Business Services Value Added in Exports in developed and developing countries

We use some of the above detailed indicators to paint a portrait of potential differences between developed and emerging economies in their patterns of participation in business services GVCs and the association between these and their domestic and distance-weighted trade-partners' demand.

For developed countries there seems to be a complementarity between domestic business services value added in foreign exports (DBSVAE) and that of partner countries (left panel of Figure 2). Countries with a higher DBSVAE share cluster with larger poles of DBSVAE activity. However, this relationship does not hold for emerging economies thereby providing some *prima facie* evidence that the links between developing a competitive BS sector in emerging countries might not be contingent on having strong BS neighbours. However, when looking at the link between domestic BS value added in exports and domestic manufacturing value added in final domestic demand (right panel of Figure 2) we find that for both emerging and developing countries there is a positive relationship. This supports the importance of domestic Hirschman-Linder linkages. [31]

Another salient feature of the data relates to the positioning of countries according to their level of development. It is clear from Figure 2 that emerging countries tend to lie below the developed country grouping in terms of their domestic BS value added in foreign exports share of gross exports. This might highlight the presence of a developmental pathway in terms of GVC participation where more developed economies predominantly participate in GVCs via exports (as evidenced by the higher domestic value added share of their exports) while emerging economies might tend to initially participate via imports (see Lee et al. 2017 and Lopez-Gonzalez and Holmes, 2011).

(Figure 2 about here)

4.4 Econometric specification

We synthesise our hypotheses in the following dynamic model:

$$DBSVAE_{it}=\alpha_1 DBSVAE_{it-1}+\underbrace{\alpha_2 bsDDEM_{it}}_{\text{Domestic Hirschman-Linder linkages}}+\underbrace{\alpha_3 DBSVAE\_par_{it}+\alpha_4 DmanufVAE\_par_{it}}_{\text{Spillover effect or GVC linkage}}+$$

[31] We compare a share to a logged value for several reasons. First, to avoid confounding factors such as size which would drive a positive correlation (i.e. larger countries would have both larger BSVAE and larger domestic demand). Second, because our conjecture relates to using domestic or foreign value added links within GVCs where the size element is likely to matter (in the same way that larger countries have smaller foreign value added shares in their exports, the size of the domestic and foreign linkage is likely to matter).

$$\alpha_5 \text{bsDDEM\_par}_{it} + \alpha_6 \text{manufDDEM\_par}_{it} + \alpha_7 \mathbf{X} + \alpha_i + \alpha_t + \nu_{it}$$

Domestic Hirschman-Linder linkages of trade partner *Controls*

Where **X** is a vector of control variables capturing: R&D and education expenditure as a share of GDP; hourly wages; Internet users; service provisions in FTAs; and the share of value added attributed to high-skilled workers (see Table A1) and α_i and α_t are respectively country and time fixed effects. In the estimated equation $DBSVAE_{it}$ is a function of α_i, and so is $DBSVAE_{i,t-1}$. This makes the Ordinary Least Squares (OLS) estimator biased and inconsistent. The fixed effects (FE) estimator eliminates α_i but will be biased for short time-series since $DBSVAE_{i,t-1}$ will be correlated with the FE-transformed residual by construction. Omitting the lagged dependent variable and estimating a static FE model could lead to problems of omitted variables and autocorrelated residuals due to the persistence in the series.

We, therefore, adopt a dynamic specification and use a Generalised Method of Moments (GMM) estimator. This estimator also helps dealing with potential problems of endogeneity. In particular, we allow domestic BS and domestic manufacturing value added in final domestic demand to be endogenous by instrumenting them with suitable lags of their own first differences.

A problem with the original Arellano-Bond estimator is that lagged levels are often poor instruments for first differences, especially for variables that are close to a random walk. Arellano and Bover (1995) described how, if the original equations in levels were added to the system, additional moment conditions could be brought to bear to increase efficiency. In these equations, predetermined and endogenous variables in levels are instrumented with suitable lags of their own first differences. We, therefore, use the system GMM developed by Blundell and Bond (1998) that has been shown to give more robust results than first-differenced GMM in the estimation of models with high persistence. Table A6 in the Appendix reports the results of the robustness checks using the traditional Arellano-Bond estimator.

The system GMM gives consistent estimates provided that there is no second order serial correlation among the errors. Therefore, we choose the number of lags in order to remove second order correlation and we report tests for first and second order autocorrelation.

5. Econometric results

We turn now to the regression results for the entire sample of countries in Table 1, including both advanced and emerging economies, and then compare the results of the estimations distinguishing between the two groups of countries (see Table A5 for details of the countries included).

We start from the simplest specification, where we include only *variables related to the domestic economy* (specifications 1). Here, we distinguish between the broader measure of domestic Hirschman-Linder linkages capturing the use of BS across all sectors - bsDDEM (specification 1a) and the more targeted manufacturing domestic Hirschman-Linder linkages, identifying the use of BS by manufacturing industries only - bsDDEMmanuf (specification 1b).

We then add the international dimension through the BS value added in final domestic demand and the value of BS forward participation of distance weighted trade partners (specifications 2a and 2b). The first variable captures the Hirschman-Linder linkages in partner countries. This variable can have a positive or negative effect, depending on whether domestic Hirschman-Linder linkages in trade partners act as an (additional) international derived demand for BS or, rather, if a competition effect dominates and displaces participation in BS GVCs. The second variable (value of BS forward participation of distance weighted trade partners) captures whether there is a "spillover" or GVC linkage effect. Bahar et al., (2014) argued, for the case of exports, that economies can benefit from knowledge spillovers ensuing from geographical proximity to countries having a comparative advantage in same products. More recently, López-Gonzalez (2016) showed how countries can increase their domestic export capacity by relying on foreign value added through GVC linkages. A positive coefficient of this variable would therefore suggest the presence of spillover or GVC linkages effect, while a negative coefficient would indicate a further displacement effect.

We also estimate a full specification that includes the BS and manufacturing value added in final domestic demand and BS forward GVC participation of distance weighted trade partners (specification 3a and 3b). This allows us to capture the role of cross-sectoral international linkages between BS and manufacturing.

(Table 1 about here)

Table 1 shows the positive effect of both total domestic Hirschman-Linder linkages (proxied by BS value added in total domestic demand) and manufacturing based ones (proxied by BS value added in manufacturing domestic demand) in explaining BS forward GVC participation. This confirms the importance of a domestic Hirschman-Linder effect. The elasticity is higher for total domestic linkages (the short and long run elasticities are 0.46 and 0.94 respectively in the full specification) than for manufacturing based ones (0.16 and 0.49 respectively). This is not surprising, as the total linkages

comprise the demand for BS coming from a larger number of sectors and also includes own demand or the direct linkage of the BS sector: on average, manufacturing based linkages account for less than 10% of total linkages.

The evidence shows the importance of domestic Hirschman-Linder linkages driving a wider participation in BS GVCs. The specific role played by manufacturing based linkages for BS forward GVC participation is also in line with the evidence of 'servicification' of manufacturing (Kommerskollegium 2012; Pilat and Wölfl 2005; Pilat et al. 2008; Lanz and Maurer 2015). The result is also consistent with the finding of the importance of manufacturing demand for regional specialization in BS (Meliciani and Savona 2014) and for attracting BS foreign direct investments (Castellani, Meliciani, and Mirra 2014). Also, it might offer support to the argument of "premature de-industrialisation" (Rodrik 2015) mentioned earlier, when a (developing) country aims to increase the global competitiveness of BS.

A second, notable result is the negative impact of BS value added in final demand of distance weighted trade partners. It suggests the presence of competition effects among countries in providing business services showing how domestic demand linkages might dominate over foreign demand. At the same time, there exist complementarities (positive spillovers) in BS forward GVC participation with respect to neighbour partner countries. That is, when countries are strong suppliers of BS within GVCs (as proxied by their forward participation in BS GVCs), neighbouring countries can benefit from positive spillovers from GVC linkages. The net effect is ambiguous and depends on the strength of the direct negative effect and the indirect positive effect (partner countries internal demand positively affects their participation in BS GVCs, which in turn positively affects one country's BS forward GVC participation)[32].

Finally, when introducing simultaneously BS and manufacturing value added in final domestic demand of distance-weighted trade partners (specification 3), the former has a displacing effect while the latter has either no effect (specification 3a) or a positive effect (specification 3b). This shows that competition effects prevail within the same sector, that is, being surrounded by countries with high levels of direct and indirect domestic demand for BS has a negative impact on BS exports from the domestic country, but there can be complementarities between sectors.

Looking at control variables, unsurprisingly the most stable determinant of BS forward GVC participation is the count of service provisions within trade agreements attesting to their importance in developing BS export capacity. On the other hand, public spending on education, the availability

[32]In order to disentangle the net effect a proper spatial GMM model should be estimated. This is left for future research.

of high skilled labour, the capital labour ratio, Internet users and labour costs are significant only in some specifications while R&D is never significant.

Table A5 in the Appendix reports robustness checks using the Arellano-Bond GMM estimator. Result are very similar, although the impact of manufacturing domestic value added in final demand of partners is negative pointing to an additional displacing effect.

Table 2 shows the results of the full specification (specification 3) on the subsamples of advanced and emerging economies (columns 1 and 2 respectively). It also separates manufacturing and BS forward GVC participation to identify differences in the results across sectors (columns 3 and 4). This allows capturing whether the importance of domestic Hirschman-Linder linkages is specific to business services or if these apply also to manufacturing. In addition, it allows us to assess how the interplay between domestic and international linkages affects manufacturing relative to BS. We report only estimates including total, rather than manufacturing only, Hirschman-Linder linkages[33].

(Table 2 about here)

The results show that the positive role of domestic Hirschman-Linder linkages for BS forward GVC participation holds for both advanced and emerging economies. The elasticity is, however, higher in the case of emerging countries (0.38 versus 0.23 for the short run elasticity and 0.81 and 0.47 for the long run elasticity), suggesting the stronger need for emerging countries to develop an internal final and intermediate demand for BS to export such services (indirectly). The most notable difference between advanced and emerging economies is the lack of significance, for emerging countries, of distance weighted trade partners' BS forward GVC participation. This suggests, in conjunction with the negative impact of BS value added in domestic demand of distance weighted trade partners that, for emerging economies, international GVC linkages do not facilitate domestic value creation in BS GVCs. Therefore, for emerging countries, contrary to common wisdom, it seems even more important to develop domestic capabilities in sectors that are backward-linked with BS in order to create domestic value in BS global value chains. In the absence of such capabilities, having neighbour partners with high levels of BS value added in final demand might only have a displacing effect.

This last result is in contrast with those obtained when looking at the determinants of forward GVC participation in manufacturing (columns 3 and 4). Domestic Hirschman-Linder linkages play an important role also in the case of manufacturing, especially for emerging countries. Moreover, as in the case for BS, there is a negative competition effect (the manufacturing value added in domestic

[33] Results on manufacturing Hirschman-Linder linkages are qualitatively similar and are available on request.

final demand of distance weighted trade partners is negative and significant). However, unlike the case of BS, the evidence shows the existence of complementary/spillover effects arising from a strong potential supply of manufacturing value added from neighbouring countries, that is, being surrounded by countries with a high forward GVC participation in manufacturing increases a country's chances to increase its own participation in manufacturing GVCs.

This suggests that proximity to large headquarter economies with a high level of manufacturing value added in foreign exports helps developing economies create domestic value added in manufacturing global value chains (Baldwin and López-Gonzalez 2014). This is not the case for BS in emerging countries implying that there are key differences in the determinants of domestic value added creation in manufacturing and BS GVCs. It suggests that Baldwin's (2011) conjectures that countries can rely on foreign linkages to develop domestic capacity might be true for manufacturing, but not for developing BS value added in emerging countries.

These results are not in contrast with the evidence that some developing countries relied on the GVC to initiate their BS exports[34] (see, for example, the case of India's IT service sector, Lee et al. 2014).

6. Concluding remarks

This paper has contributed to the literature on Global Value Chains by putting forward and empirically testing the conjecture that (direct and indirect) domestic demand for business services affects the capability of countries to engage in BS global value chains. The question has been framed within the recent debate on the development opportunities of joining a business service GVC, sparked in both academic and policy circles. More generally, we argue that part of this debate is linked to the importance of developing domestic capacity and capabilities in sectors that are crucial to facilitate processes and achieve outcomes of sectoral and technological upgrading, to fully gain from insertion in GVCs.

Recent developments in international trade theory (Antras and Rossi-Hansberg 2006; Grossman and Rossi-Hansberg 2006, 2008 and 2012; Costinot, Vogel, and Wang 2013; Baldwin and Robert-Nicoud 2014) suggest that the emergence of GVC has changed the object of comparative advantage – now

[34] As a robustness check, we have tried out a specification that tests our Hirschman Linder hypothesis by considering countries according to their stage of development in each period (see Table A5). The findings of this specification (Table A8) are robust to our main conclusion for upper-middle income countries (emerging countries) and, in addition, the coefficients for spillovers are significant for low and low middle income. Although based on a small sample of countries, and limited to the forward participation, the results shown in Table A8 seem to be in line with Lee at al. (2017), suggesting that countries at early stages of development can start from joining GVC but at later stages it is more difficult to create BS domestic value added in GVCs without developing internal capabilities through domestic linkages.

based on *tasks* rather than *products,* whereas the determinants of it, i.e. relative endowment of factors, skills and factors' prices remain largely unchanged. From an empirical perspective, scholars have argued that proximity to headquarters countries, which tend to offshore the low value adding segments of production to neighbouring factor economies, might be an important driver of participation in manufacturing GVCs (Baldwin 2011; Baldwin and López-Gonzalez 2015). Along these lines, qualitative evidence on country cases that supports the idea of favouring GVC in BS as an opportunity for development has emerged. (Gereffi and Fernandez-Stark 2010; Hernández, Mulder, Fernandez-Stark, Sauvé, and López Giral 2014; Hernández, Martínez-Piva, and Mulder 2014.)

This paper has proposed a different framework to explain the emergence of BS GVCs, and drawn different implications in terms of conditions to participating in BS GVCs in the absence of a core domestic demand and presence of backward linked sectors.

Our results show that the higher the domestic presence in BS backward-linked industries, and particularly manufacturing sectors, the higher the propensity to participate in BS GVCs. This is in line with what Linder claimed to be the case for the composition of final domestic demand favouring trade in similar sectors. In particular, our findings show that our Hirschman-Linder hypothesis holds for the (WIOD) sample of developed and emerging countries and, indeed, for the subsample of emerging countries only. However, when we look at whether participation in BS GVC is driven by domestic demand of close trade partners, we find that this has a negative effect. This is at odds with the idea that countries can enter BS global value chains by relying exclusively or mainly on demand coming from trade partner countries, regardless of their own domestic productive structure. This result emerges more clearly for emerging countries, for which it seems that it is even more important to develop domestic capabilities in sectors that are vertically integrated with BS in order to enter BS global value chains.

Although the investigation of how the determinants of participation in GVCs change as countries grow is out of the scope of this paper, our findings are in line with the conjectures put forward by Lee et al. (2017), Lee and Malerba (2017), Baldwin, (2013) and Lopez-Gonzalez and Holmes (2011), who have looked at the relationship between levels of development and participation in GVCs. According to these, countries tend to predominantly rely on foreign inputs at early stages of development (high intensity of backward participation) and predominantly contribute to foreign exports at later stages of development (high intensity of forward participation). Further analyses based on data that cover also low income countries might shed more light on this relevant issue.

The descriptive evidence on cases such as (a few states in) India, the Philippines or Uruguay, whereby trade specialisation and participation in service GVCs has been mainly driven by external demand, offer counter-evidence to our findings.[35] However, recent developments in measurement of trade specialisation in terms of trade in value added rather than gross exports, seem to put these claims largely in perspective (see mainly Koopman et al., 2014, but also Banga (2014), Francois et al. (2015) and Miroudot and Cadestin (2017)). These are indeed interesting cases to observe over the next decades, to assess their long-term development paths.

Given the link between domestic and trade specialisation, and in a context where the debate is putting back to the forefront the risks of a "premature de-industrialisation" (Rodrik 2015), it is all the more relevant to provide generalisable evidence on this phenomenon. Indeed, empirical evidence in (Dasgupta and Singh 2005; Dasgupta and Singh 2006; Bah 2011; Di Meglio et al. 2018) shows that most Latin American and African countries are de-industrialising at levels of aggregate incomes that are much lower than those at which developed countries started to shift to services, with consequences that at best are a slowdown of aggregate growth and employment. This literature rarely takes into account the role of global trade, most especially from the point of view of how changes in domestic structure and demand might condition the ability to benefit from trade, conducive of economic development, with notable exceptions (McMillan, Rodrik, and Verduzco-Gallo 2014; Rodrik 2015).

We see therefore two main directions that would be worth pursuing within our future research agenda.

The first one is to provide a better conceptual and empirical ground to understand the impact of GVC participation on the polarisation of income, both within and between countries.[36] Assessing these processes by means of quantitative analysis allows contributing to a different, yet established stream of scholarship, interested in the distribution of rents along the value chains. Kaplinsky (2000), for instance, points to the sources of income inequality linked to the spatial distribution of production activities between headquarters and factory economies. Many of these asymmetries of the gains of be part of GVCs are attributable to issues of *governance* (Kaplinsky 2000; Gereffi, Humphrey, and Sturgeon 2005). More broadly, it would be important to disentangle the inevitable nexus between being a headquarter versus a factory economy, and give empirical content to the dynamics of rent

[35] BS might behave differently, as not all BS are knowledge intensive, or have to rely on domestic demand. For instance, India initially promoted BPO by relying on foreign demand. However, the data at our disposal do not allow us to further disaggregate BS into low and high knowledge intensive to test whether they actually behave differently. Indeed, as included in footnote 19 above, we also run the main regressions using the hourly wage of medium and low skilled workers, which could indirectly capture differences between subsectors of BS, but these were never significant.

[36] See López-Gonzalez, Kowalski, and Achard (2015) for a preliminary appraisal of the role of GVCs in determining within country wage inequality.

appropriation along different portions of the value chain. It is in the dynamics of this nexus that different development scenarios might arise for emerging countries.

The second, related, one is providing an explicit conceptual and empirical link between GVC scholarship and the debate over industrial policy for development (Lin 2012; Stiglitz, Lin, and Monga 2013). One of the relevant questions to this debate is, for instance, whether entering GVCs in BS allows or speeds up the processes of technological upgrading of domestic manufacturing that BS have been found to facilitate internally. Informing this debate requires generalisable, longitudinal and cross-country empirical evidence on the extent of these phenomena, to track the 'upgrading' process and derive implications in terms of industrial policy. As a consequence, the policy implications based on our evidence are necessarily tentative here.

Overall, our evidence calls for some caution – or at least helps spark further discussion - on the opportunities and challenges to favour participation in BS GVC as a development strategy. In particular, it warns countries that relying first and foremost, let alone exclusively, on foreign demand, while overlooking efforts to build capabilities by developing domestic backward-linked industries to BS, might not result in gaining from GVC participation, or even in lock-ins in low value added segments of GVCs. Such efforts would require a coherent set of innovation and industrial policy in emerging countries, that would need to achieve 'quality' industrialisation (e.g. in high-value intermediates) rather than simply augmenting their production capacity to serve foreign demand. Similarly, although mainly focusing on regional development in advanced countries, the literature on related and unrelated variety has pointed to the importance of the domestic structure of related activities to tackle regional development unbalances (Boschma and Frenken, 2011; Boschma and Iammarino, 2009).

It is not immediate to identify appropriate policy tools in support of domestic and trade diversification in emerging countries, to achieve both 'quality' industrialization and value creation through participation in GVCs. Based on our evidence, but also on the literatures on GVCs, related variety and technological upgrading, we propose below what the main ingredients and ideal sequence of actions would entail.

First, countries should build upon their initial specialization to identify related (backward and forward linked) sectors, that represent feasible pathways for structural transformation. This view has been largely supported in the economic geography literature (Frenken et al., 2007) but also, more recently, by the product space framework (Hidalgo et al., 2007; Hausmann et al., 2007). This essentially puts forward the argument that the ability of countries to transition from one set of activities to another is

based on their existing capabilities, the nestedness of their specialisation and relative positions in global trade networks. However, capabilities building as a policy goal might need to go beyond the density of countries' product space and requires a direct, deliberate effort to support technological upgrading via targeted innovation policies (Ciarli et al., 2018).

A second step should therefore entail support of traditional technology transfer during the initial stages of development, assuming that this fits the local characteristics and contributes to the development of domestic capabilities. Currently there is little reflection – mostly based on case studies - on whether inclusion in GVCs, let alone BS GVCs, facilitates technological upgrading via some form of transfer (Fu et al., 2011; Pietrobelli et al., 2011). Again, this would require a dedicated effort to identify technological opportunities that best fit the initial indigenous capability for technological upgrading, which is core to the quality and direction of structural change and development (Bell, 2009; Barrientos et al., 2011; Fu et al., 2011; Ciarli et al., 2018).

At any rate, forms of learning linked to GVCs participation would require a minimal, critical mass of competitive domestic sectors, to maximize the renting positions linked to serving foreign demand (Kaplinsky, 2018), and facilitate strengthening of domestic linkages and further upgrading. This argument is far from discouraging *tout court* participation in BS GVC at the initial stages of development. Rather, we suggest that joining BS GVC can indeed be an opportunity for emerging countries, but that in order to avoid being locked in low value added activities, they might need to develop closely related (backward and forward linked) domestic sectors. Recent evidence seems to support these suggestions.

A recent OECD report (OECD, 2017) shows that, despite India being considered a key services exporter and China considered a manufacturing hub, the services employment content of GDP has increased much faster in China than in India. Arguably, "*a supporting services sector has been essential, but largely overlooked part of China's industrial development*" (OECD, 2017, p 13). Along the same lines, data reported in the Global Value Chain Development Report (World Bank, 2017, p.11) show that: *"Emerging market economies that are major exporters of manufactured products have somewhat lower but still surprisingly high services shares. For example, China, Mexico, and Vietnam have very little direct export of services, but in value added terms about 40% of their exports come from services. They can expect that share to rise as they develop further and move up the value chain"*. In addition: *"India offers an example of "premature deindustrialization," where direct exports of business services are high but indirect exports are low, perhaps because of the relative weakness of goods sectors* (World Bank, 2017, p. 152).

We trust that the present work, alongside recent OECD evidence, not only signposts a fruitful direction for empirical efforts, but informs concerted directions of policy action, that coherently addresses the need for domestic technological upgrading and sectoral transformation while ensuring a gainful insertion on GVCs for emerging countries.

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Tables

Table 1: System GMM estimations of BS value added in foreign exports

	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
BS value added in foreign exports lag 1	0.672	0.510	0.515	0.957	0.900	0.822
	(4.15)***	(3.31)***	(3.27)***	(9.41)***	(8.69)***	(8.48)***
BS value added in foreign exports lag 2	-0.053	-0.053	-0.050	-0.136	-0.156	-0.150
	(-0.72)	(-0.77)	(-0.72)	(-2.26)**	(-2.74)***	(-2.86)***
BS value added in total final demand	0.352	0.506	0.457			
	(3.79)***	(5.62)***	(4.65)***			
BS value added in manufacturing final demand				0.143	0.167	0.163
				(2.59)***	(2.77)***	(3.14)***
BS VA in foreign exports of partners		1.855	1.821		1.076	1.237
		(2.78)***	(2.20)**		(3.36)***	(2.72)***
BS VA in final demand of partners		-0.956	-1.385		-0.400	-1.547
		(-3.21)***	(-2.46)**		(-2.68)***	(-2.66)***
Manufacturing VA in foreign exports of partners			0.064			0.128
			(0.14)			(0.34)
Manufacturing VA in final demand of partners			0.416			1.004
			(0.89)			(2.09)**
Public expenditure on education over GDP	0.131	0.043	0.089	0.392	0.356	0.406
	(0.79)	(0.24)	(0.53)	(2.68)***	(2.56)**	(2.99)***
R&D over GDP	0.067	-0.003	-0.014	0.007	-0.028	-0.036
	(0.53)	(-0.04)	(-0.2)	(0.14)	(-0.93)	(-1.53)
Hourly wage of high skilled workers	-0.22	-0.427	-0.358	0.007	-0.093	-0.013
	(-2.36)**	(-4.14)***	(-3.82)***	(0.07)	(-1.03)	(-0.14)
Internet users per 100 people	0.018	0.076	0.051	-0.049	-0.047	-0.062
	(0.40)	(2.19)**	(1.38)	(-1.11)	(-1.03)	(-1.39)
Count of provisions stimulating the liberalization	0.008	0.006	0.007	0.004	0.004	0.008
of trade in services	(3.61)***	(2.29)**	(2.47)**	(1.94)*	(1.43)	(3.52)***
Share of direct VA attributed to high skilled	0.17	0.181	0.131	0.131	0.235	0.089
labour returns	(1.13)	(1.17)	(0.88)	(1.29)	(1.84)*	(0.64)
Capital labour ratio	0.084	0.097	0.118	-0.012	-0.008	0.042
	(2.44)**	(3.08)***	(3.31)***	(-0.57)	(-0.34)	(-1.47)
Constant	-0.569	-3.387	-2.088	-0.06	-1.933	-2.81
	(-0.82)	(1.67)*	(-1.41)	(-0.13)	(-1.55)	(1.79)*
Arellano-Bond test for AR(1)	-2.73***	-2.27**	-2.26**	-3.44***	-3.42***	-3.35***
Arellano-Bond test for AR(2)	-0.74	-0.60	-0.46	-0.60	-0.60	-0.48
Observations	417	417	417	417	417	417

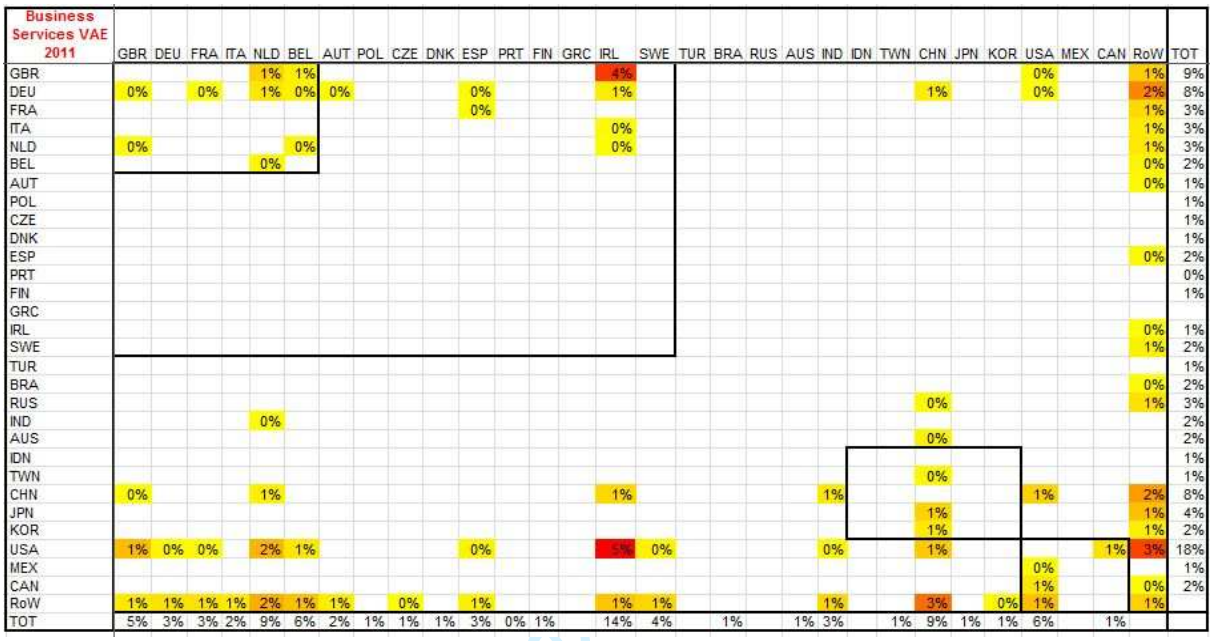
Note: Year dummies included but not reported. Standard errors are heteroscedasticity robust. *, ** and *** indicate significant at 10, 5 and 1% respectively.

Table 2: System GMM estimations of BS and manufacturing value added in foreign exports for advanced and emerging economies

	Business services		Manufacturing	
	Emerging	Advanced	Emerging	Advanced
BS value added in foreign exports lag 1	0.532	0.515		
	(2.72)***	(9.29)***		
BS value added in foreign exports lag 2	-0.044	0.059		
	(-0.46)	(1.25)		
BS value added in total final demand	0.38	0.232		
	(3.82)***	(4.45)***		
Manufacturing VA in foreign exports lag 1			0.441	0.755
			(2.86)***	(6.46)***
Manufacturing VA in foreign exports lag 2			0.007	0.087
			(0.22)	(0.8)
Manufacturing value added in total final demand			0.472	0.076
			(5.43)***	(2.55)**
BS VA in foreign exports of partners	1.968	1.369	-1.262	-0.379
	(1.5)	(5.42)***	(-2.21)**	(-3.04)***
Manufacturing VA in foreign exports of partners	-0.212	0.157	3.511	1.319
	(-0.19)	(1.07)	(3.60)***	(7.71)***
BS VA in final demand of partners	-2.028	-0.468	-1.835	-0.776
	(2.71)***	(2.58)***	(-2.97)***	(-3.82)***
Manufacturing VA in final demand of partners	1.023	-0.034	0.341	0.358
	(1.51)	(-0.17)	(0.7)	(1.75)*
Public expenditure on education over GDP	-0.051	0.137	0.071	-0.014
	(-0.21)	(1.25)	(0.43)	(-0.3)
R&D over GDP	-0.077	-0.021	0.008	-0.125
	(-1.73)*	(-0.28)	(0.2)	(-2.22)**
Hourly wage of high skilled workers	-0.357	-0.35	-0.272	-0.156
	(-2.50)**	(-3.26)***	(-5.50)***	(-2.57)**
Internet users per 100 people	-0.025	-0.038	-0.11	0.006
	(-0.29)	(-1.27)	(-1.05)	(0.25)
Count of provisions stimulating the liberalization	0.004	0.00	0.005	-0.002
of trade in services	(1.17)	(0.08)	(1.27)	(-1.31)
Share of direct VA attributed to high skilled	0.207	0.12	0.257	0.106
labour returns	(1.01)	(1.19)	(1.64)	(1.42)
Capital labour ratio	0.142	0.31	0.041	0.229
	(2.50)**	(2.05)**	(0.63)	(3.00)***
Constant	-1.083	-2.875	-3.212	-2.483
	(-0.47)	(-2.67)***	(-1.5)	(-3.85)***
Arellano-Bond test for AR(1)	-1.49	-2.14**	-1.53	-2.43**
Arellano-Bond test for AR(2)	-1.25	-0.26	-0.11	-1.34
Observations	165	252	165	252

Figures

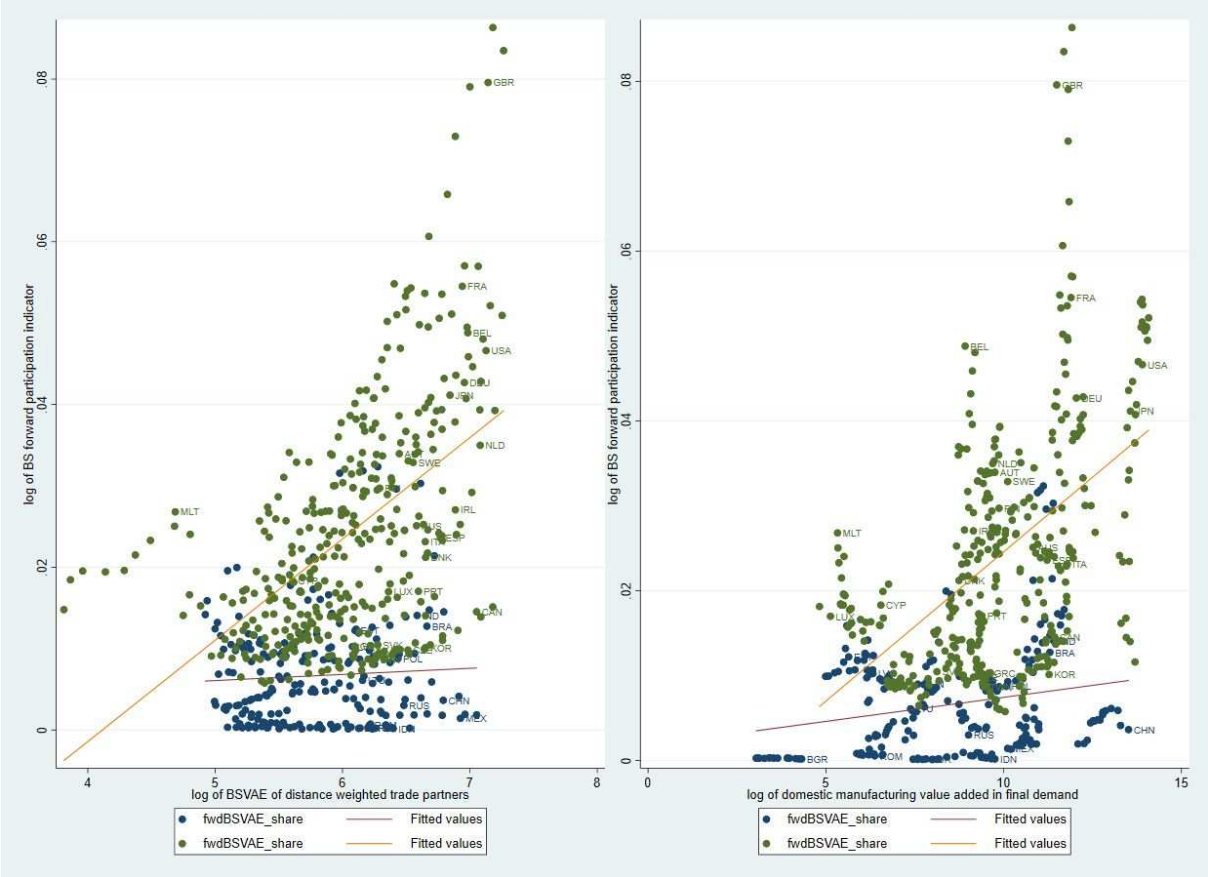
Figure 1 – Business Services Value Added in Export (BSVAE)



Business Services VAE 2011	GBR	DEU	FRA	ITA	NLD	BEL	AUT	POL	CZE	DNK	ESP	PRT	FIN	GRC	IRL	SWE	TUR	BRA	RUS	AUS	IND	IDN	TWN	CHN	JPN	KOR	USA	MEX	CAN	RoW	TOT
GBR					1%	1%									4%												0%			1%	9%
DEU	0%		0%		1%	0%	0%				0%				1%									1%			0%			2%	8%
FRA											0%																			1%	3%
ITA															0%															1%	3%
NLD	0%					0%									0%															1%	3%
BEL					0%																									0%	2%
AUT																														0%	1%
POL																															1%
CZE																															1%
DNK																															1%
ESP																														0%	2%
PRT																															0%
FIN																															1%
GRC																															
IRL																														0%	1%
SWE																														1%	2%
TUR																															1%
BRA																														0%	2%
RUS																								0%						1%	3%
IND					0%																										2%
AUS																								0%							2%
IDN																															1%
TWN																								0%							1%
CHN	0%				1%										1%						1%						1%			2%	8%
JPN																								1%						1%	4%
KOR																								1%							2%
USA	1%	0%	0%		2%	1%					0%				5%	0%					0%			1%					1%	3%	18%
MEX																											0%				1%
CAN																											1%				2%
RoW	1%	1%	1%	1%	2%	1%	1%		0%		1%				1%	1%					1%			3%		0%	1%			1%	
TOT	5%	3%	3%	2%	9%	6%	2%	1%	1%	1%	3%	0%	1%		14%	4%		1%		1%	3%		1%	9%	1%	1%	6%		1%		

Source: Own calculations using WIOD

Figure 2 –Domestic Business Services Value Added in Foreign Export and domestic and GVC linkages.



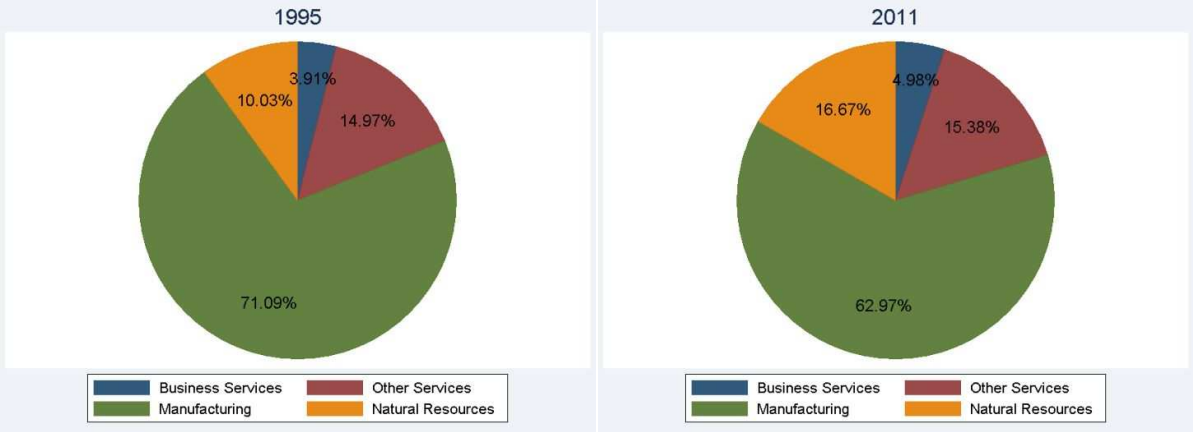
Source: Own calculations using WIOD

Note: The vertical axis represents the share of domestic business services value added in foreign gross exports. The left panel relates this to the log of BSVA of distance weighted trade partners to capture international linkages. The right panel then uses the log of business service value added used by domestic manufacturing industries to satisfy final domestic demand to represent domestic linkages.

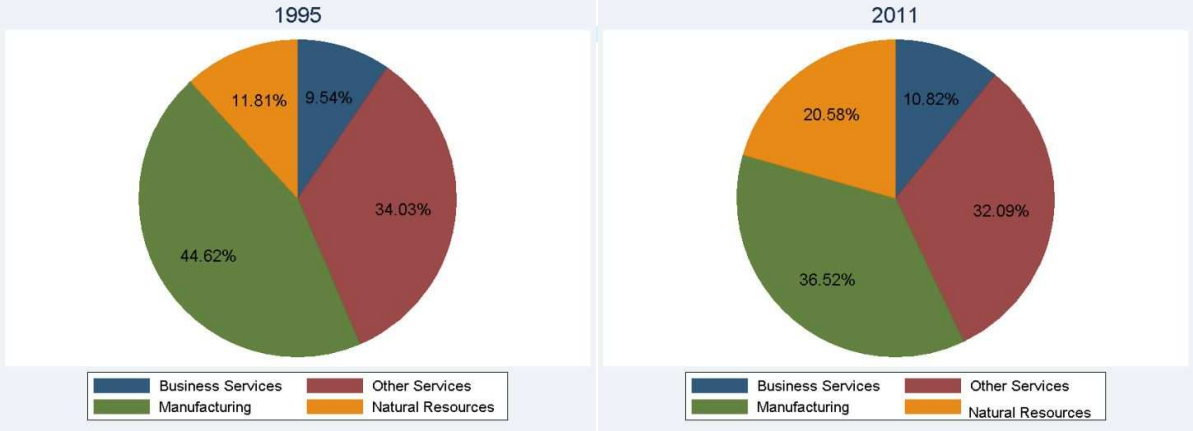
Appendix

Figure A-1 Share of Gross Exports (a) and share of Value Added in Gross Exports (b) by Category

(a)



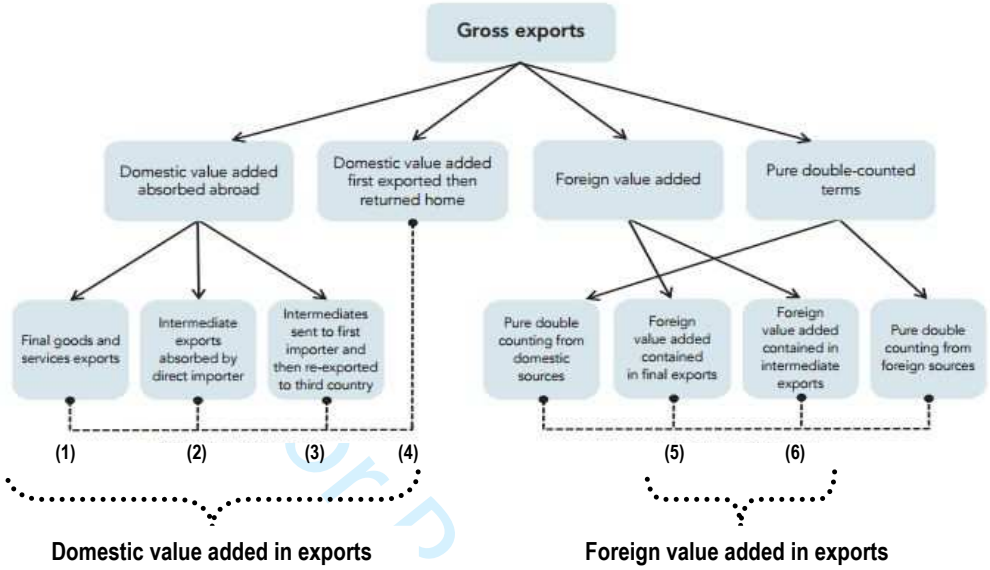
(b)



Source: Own calculations using WIOD

Note: Gross exports show direct exports across selected sectors. Value added figures show the contribution of each sector towards the creation of these gross exports. Business Services are identified as sector c30 in the WIOD which corresponds to ISIC sectors 71-74.

Figure A-2 Gross trade accounting framework



Source: adapted from WBG-IDE-OECD-UIBE-WTO (2017)

Table A-1 Description of the variables

Variable	Description of variable	Measure for	Source
DBSVAE	Domestic business service value added used to produce foreign gross exports	Domestic participation in BS GVCs	Own calculations WIOD
DmanufVAE	Domestic manufacturing value added used to produce foreign gross exports	Domestic participation in manufacturing GVCs	Own calculations WIOD
bsDDEMmanuf	Domestic business service value added used by domestic manufacturing sector to satisfy domestic final demand.	Domestic BS Hirschman-Linder Linkages with respect to manufacturing demand	Own calculations WIOD
bsDDEM	Domestic business service value added used by all domestic sectors to satisfy domestic final demand.	Domestic BS Hirschman-Linder Linkage with respect to all sectors	Own calculations WIOD
manufDDEM	Domestic manufacturing value added used by all domestic sectors to satisfy domestic final demand.	Domestic manufacturing Hirschman-Linder Linkage with respect to all sectors	Own calculations WIOD
manufDDEMmanuf	Domestic manufacturing value added used by domestic manufacturing sector to satisfy domestic final demand.	Domestic manufacturing Hirschman-Linder Linkage with respect to manufacturing demand	Own calculations WIOD
bsDDEM_par	Distance weighted domestic BS value added of partner countries used to satisfy their domestic demand	Domestic BS Hirschman-Linder Linkages of distance weighted trade partners	Own calculations WIOD
manufDDEM_par	Distance weighted domestic manufacturing value added of partner countries used to satisfy their domestic demand	Domestic manufacturing Hirschman-Linder Linkages of distance weighted trade partners	Own calculations WIOD
DBSVAE_par	Distance weighted partner domestic BS value added in foreign gross exports	Potential spillover effects or GVC linkages in BS	Own calculations WIOD
DmanufVAE_par	Distance weighted partner domestic manufacturing value added in foreign gross exports	Potential spillover effects or GVC linkages in manufacturing	Own calculations WIOD
rd	R&D over GDP	Proxy for technology or innovative capacity	Castellacci and Natera 2011
waw_hs	Average hourly wage of highly-skilled workers	Wages	WIOD – SEAs
internetusers	Number of Internet users	Proxy for technology or digital infrastructure	Castellacci and Natera 2011
services	Count of trade agreements with service provisions	Degree of service openness	DESTA
toths	Share of direct value added attributed to highly-skilled labour	As measure of factor endowments	WIOD – SEAs
edu	Public expenditure on education over GDP	Proxy for human capital	Castellacci and Natera 2011
kl	Capital labour ratio	As measure of productivity	WIOD – SEAs

Table A2 – Descriptive statistics of variables used in regressions

Variable	Obs	Mean	Std. Dev.	Min	Max
BS forward linkages *	580	4650.62	9722.83	1.39	66045.30
Manuf. forward linkages *	580	15018.85	26888.77	11.75	175823.00
BS value added in manufacturing final demand *	580	4594.54	14061.84	0.16	93857.17
BS value added in total final demand *	580	55352.00	166288.40	7.55	1190219.00
Manuf. value added in total final demand *	580	86837.88	210068.80	20.91	1301799.00
BS VA in final demand of partners *	580	1306.88	995.64	117.47	6144.92
Manufacturing VA in final demand of partners *	580	1661.11	1453.63	145.40	9124.29
BS VA in forward linkages of partners *	580	146.00	98.24	13.70	558.77
Manuf. VA in forward linkages of partners *	580	471.30	284.98	46.30	1906.77
R&D over GDP %	565	1.38	0.92	0.01	4.24
Hourly wage of high skilled workers	580	14.55	10.93	0.46	49.89
Internet users per 100 people	570	30.28	26.11	0.00	91.00
Count of provisions for the liberalization of trade in serv.	545	21.69	19.15	0.00	70.00
Share of direct VA attributed to high skilled labour returns	580	0.13	0.05	0.02	0.36
Public expenditure on education over GDP %	441	4.93	1.28	0.00	8.74
Capital labour ratio	580	95.85	91.01	0.00	364.01
*values in million USD deflated to 1995 prices using value added deflators					

Table A3 – Correlation coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
BS value added in total final demand (1)	1												
BS value added in manufacturing final demand (2)	0.96	1.00											
BS VA in forward linkages of partners (3)	0.52	0.42	1.00										
BS VA in final demand of partners (4)	0.66	0.59	0.79	1.00									
Manufacturing VA in forward linkages of partners (5)	0.59	0.51	0.92	0.85	1.00								
Manufacturing VA in final demand of partners (6)	0.63	0.60	0.49	0.88	0.72	1.00							
Public expenditure on education over GDP (7)	0.07	0.02	0.09	-0.12	-0.13	-0.35	1.00						
R&D over GDP (8)	0.56	0.57	0.32	0.24	0.33	0.18	0.42	1.00					
Hourly wage of high skilled workers (9)	0.51	0.45	0.37	0.18	0.24	-0.04	0.59	0.65	1.00				
Internet users per 100 people (10)	0.23	0.17	0.60	0.29	0.48	0.01	0.48	0.55	0.67	1.00			
Count of prov. stimulating the liberaliz. of serv. (11)	0.17	0.12	0.25	-0.17	0.04	-0.41	0.41	0.27	0.62	0.39	1.00		
Sh. of direct VA attributed to high skill. lab. ret. (12)	0.23	0.20	0.02	-0.09	-0.02	-0.14	0.57	0.54	0.60	0.42	0.29	1.00	
Capital labour ratio (13)	0.48	0.51	0.25	0.12	0.16	-0.03	0.56	0.78	0.78	0.57	0.50	0.60	1.00

Table A4 –WIOD sectors (International Standard Industry Classification codes)

ISIC	Description	i	Type
AtB	Agriculture, Hunting, Forestry and Fishing	1	Primary
C	Mining and Quarrying	2	Primary
15t16	Food, Beverages and Tobacco	3	Manufacturing
17t18	Textiles and Textile Products	4	Manufacturing
19	Leather, Leather and Footwear	5	Manufacturing
20	Wood and Products of Wood and Cork	6	Manufacturing
21t22	Pulp, Paper, Paper , Printing and Publishing	7	Manufacturing
23	Coke, Refined Petroleum and Nuclear Fuel	8	Manufacturing
24	Chemicals and Chemical Products	9	Manufacturing
25	Rubber and Plastics	10	Manufacturing
26	Other Non-Metallic Mineral	11	Manufacturing
27t28	Basic Metals and Fabricated Metal	12	Manufacturing
29	Machinery, Nec	13	Manufacturing
30t33	Electrical and Optical Equipment	14	Manufacturing
34t35	Transport Equipment	15	Manufacturing
36t37	Manufacturing, Nec; Recycling	16	Manufacturing
E	Electricity, Gas and Water Supply	17	Other Services
F	Construction	18	Other Services
50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	19	Other Services
51	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	20	Other Services
52	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	21	Other Services
H	Hotels and Restaurants	22	Other Services
60	Inland Transport	23	Other Services
61	Water Transport	24	Other Services
62	Air Transport	25	Other Services
63	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	26	Other Services
64	Post and Telecommunications	27	Other Services
J	Financial Intermediation	28	Other Services
70	Real Estate Activities	29	Other Services
71t74	Renting of M&Eq and Other Business Activities	30	Business Services
L	Public Admin and Defence; Compulsory Social Security	31	Other Services
M	Education	32	Other Services
N	Health and Social Work	33	Other Services
O	Other Community, Social and Personal Services	34	Other Services
P	Private Households with Employed Persons	35	Other Services

Table A5: WIOD country coverage and countries' classification

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Low income (L)	<= 765	<= 785	<= 785	<= 760	<= 755	<= 755	<= 745	<= 735	<= 765	<= 825	<= 875	<= 905	<= 935	<= 975	<= 995
Lower middle income (LM)	766-3,035	786-3,115	786-3,125	761-3,030	756-2,995	756-2,995	746-2,975	736-2,935	766-3,035	826-3,255	876-3,465	906-3,595	936-3,705	976-3,855	996-3,945
Upper middle income (UM)	3,036-9,385	3,116-9,645	3,126- 9,655	3,031-9,360	2,996-9,265	2,996-9,265	2,976-9,205	2,936-9,075	3,036-9,385	3,256-10,065	3,466-10,725	3,596-11,115	3,706-11,455	3,856-11,905	3,946-12,195
High income (H)	> 9,385	> 9,645	> 9,655	> 9,360	> 9,265	> 9,265	> 9,205	> 9,075	> 9,385	> 10,065	> 10,725	> 11,115	> 11,455	> 11,905	> 12,195
Australia	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Austria	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Belgium	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Brazil*	UM	UM	UM	UM	UM	UM	UM	LM	LM	LM	LM	UM	UM	UM	UM
Bulgaria*	LM	LM	LM	LM	LM	LM	LM	LM	LM	LM	LM	UM	UM	UM	UM
Canada	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
China*	L	L	LM	L	LM	LM	LM	LM	LM	LM	LM	LM	LM	LM	LM
Cyprus	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Czech Republic	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	H	H	H	H
Denmark	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Estonia*	LM	LM	UM	UM	UM	UM	UM	UM	UM	UM	UM	H	H	H	H
Finland	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
France	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Germany	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Greece	UM	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Hungary*	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	H	H	H
India*	L	L	L	L	L	L	L	L	L	L	L	L	LM	LM	LM
Indonesia*	LM	LM	LM	L	L	L	L	L	LM	LM	LM	LM	LM	LM	LM
Ireland	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Italy	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Japan	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Korea, Rep.	H	H	H	UM	UM	UM	H	H	H	H	H	H	H	H	H
Latvia*	LM	LM	LM	LM	LM	LM	UM	UM	UM	UM	UM	UM	UM	UM	H
Lithuania*	LM	LM	LM	LM	LM	LM	UM	UM	UM	UM	UM	UM	UM	UM	UM
Luxembourg	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Malta	UM	UM	UM	H	UM	H	UM	H	H	H	H	H	H	H	H
Mexico*	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM
Netherlands	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Poland*	LM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	H
Portugal	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Romania*	LM	LM	LM	LM	LM	LM	LM	LM	LM	LM	UM	UM	UM	UM	UM
Russian Federation*	LM	LM	LM	LM	LM	LM	LM	LM	LM	UM	UM	UM	UM	UM	UM
Slovak Republic	LM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	UM	H	H	H
Slovenia	UM	UM	H	H	H	H	H	H	H	H	H	H	H	H	H
Spain	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Sweden	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Taiwan, China	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Turkey*	LM	LM	UM	UM	LM	UM	LM	LM	LM	UM	UM	UM	UM	UM	UM
United Kingdom	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
United States	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Table A6 – Arellano-Bond estimations of BS value added in foreign exports

	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
BS value added in foreign exports lag 1	0.468	0.396	0.402	0.449	0.33	0.348
	(13.77)***	(12.04)***	(11.76)***	(12.60)***	(9.72)***	(10.04)***
BS value added in total final demand	0.166	0.156	0.229			
	(2.15)**	(2.21)**	(3.01)***			
BS value added in manufacturing final demand				0.106	0.136	0.137
				(5.96)***	(8.38)***	(8.29)***
BS VA in foreign exports of partners		1.781	1.939		2.238	2.110
		(6.50)***	(5.25)***		(8.45)***	(6.05)***
BS VA in final demand of partners		-0.74	-0.464		-1.147	-0.824
		(-3.85)***	(-1.86)*		(-6.00)***	(-3.47)***
Manufacturing VA in foreign exports of partners			0.038			0.255
			(0.13)			(0.98)
Manufacturing VA in final demand of partners			-0.656			-0.546
			(-2.09)**			(-1.99)**
Public expenditure on education over GDP	-0.058	-0.084	-0.076	0.002	0.012	0.018
	(-0.76)	(-1.19)	(-1.06)	(0.02)	(0.17)	(0.25)
R&D over GDP	-0.019	-0.03	-0.025	0.066	0.057	0.065
	(-0.50)	(-0.85)	(-0.70)	(1.75)*	(1.68)*	(1.88)*
Hourly wage of high skilled workers	-0.121	-0.235	-0.26	-0.168	-0.307	-0.296
	(-2.12)**	(-3.94)***	(-4.24)***	(-3.05)***	(-5.75)***	(-5.46)***
Internet users per 100 people	0.077	0.097	0.104	0.089	0.113	0.101
	(3.06)***	(4.13)***	(3.75)***	(3.57)***	(5.04)***	(3.97)***
Count of provisions stimulating the liberalization	0.001	0.001	0.000	0.001	0.003	0.001
of trade in services	(0.44)	(0.67)	(0.2)	(0.59)	(1.53)	(0.78)
Share of direct VA attributed to high skilled	0.247	0.109	0.149	0.346	0.302	0.31
labour returns	(2.45)**	(1.15)	(1.53)	(3.16)***	(3.10)***	(3.13)***
Capital labour ratio	0.351	0.419	0.357	0.485	0.554	0.546
	(3.83)***	(5.04)***	(4.12)***	(9.25)***	(11.79)***	(11.57)***
Constant	1.364	-2.486	0.92	2.059	-1.005	1.648
	(2.57)**	(-1.36)	(0.53)	(4.81)***	(-0.60)	(1.03)
Observations	414	414	414	414	414	414

Note: Year dummies included but not reported. Standard errors are heteroscedasticity robust. *, ** and *** indicate significant at 10, 5 and 1% respectively

Table A7 – Estimations of BS value added in total exports

	Business services VA in exports		Manufacturing VA in exports	
	Emerging	Advanced	Emerging	Advanced
BS (or manufacturing) value added in exports lag 1	0.470	0.561	0.414	0.822
	(2.29)**	(8.34)***	(2.62)***	(6.41)***
BS (or manufacturing) value added in exports lag 2	0.037	0.078	-0.073	-0.052
	(0.57)	(1.99)**	(1.99)**	(0.63)
BS (or manufacturing) value added in total final demand	0.344	0.152	0.579	0.074
	(2.75)***	(2.99)***	(5.15)***	(2.29)**
BS VA in exports of partners	1.828	0.954	-1.194	-0.496
	(1.62)	(3.01)***	(-1.27)	(-2.50)**
Manufacturing VA in exports of partners	-1.070	0.303	4.194	1.308
	(-0.98)	(1.22)	(3.01)***	(5.71)***
BS VA in final demand of partners	-2.425	-0.255	0.704	0.441
	(-2.99)***	(-0.94)	(1.14)	(2.52)**
Manufacturing VA in final demand of partners	2.138	-0.065	-2.818	-0.789
	(2.05)**	(-0.22)	(2.82)***	(3.31)***
Public expenditure on education over GDP	-0.032	0.124	0.108	0.071
	(-0.16)	(1.19)	(0.75)	(1.61)
R&D over GDP	-0.032	0.031	-0.103	-0.084
	(-0.51)	(0.55)	(-1.90)*	(-1.85)*
Hourly wage of high-skilled	-0.317	-0.261	-0.217	-0.062
	(2.02)**	(3.08)***	(3.85)***	(-1.08)
Internet users per 100 people	-0.045	-0.007	-0.017	0.056
	(-0.61)	(-0.3)	(-0.19)	(2.92)***
Count of provisions stipulating	0.010	0.004	0.012	0.000
the liberalization of trade in services	(2.47)**	(1.69)*	(3.09)***	-0.140
Share of direct VA attributed to	0.201	0.054	0.023	0.118
high skilled labor returns	(0.98)	(0.58)	(0.13)	(1.33)
Capital labour ratio	0.162	0.294	0.028	0.105
	(2.75)***	(2.34)**	(0.67)	(1.42)
Constant	-0.379	-5.474	-7.748	-2.446
	(-0.11)	(6.41)***	(2.83)***	(3.21)***
Arellano Bond test for AR(1)	-1.115	-1.999**	-2.122**	-3.475***
Arellano Bond test for AR(2)	-1.172	-0.519	-1.426	-0.827
Observations	165	252	165	252

Note: Year dummies included but not reported. Standard errors are heteroscedasticity robust. *, ** and *** indicate significant at 10, 5 and 1% respectively.

Table A8 – System GMM estimations of BS value added in foreign exports for upper-middle and Low and Lower-middle income countries

	Upper-middle income	Low and Lower-middle income
BS value added in foreign exports lag 1	0.453	0.361
	(4.53)***	(3.44)***
BS value added in foreign exports lag 2	0.137	0.096
	(1.72)*	(1.98)**
BS value added in total final demand	0.24	0.442
	(2.43)**	(2.88)***
BS VA in foreign exports of partners	0.772	6.331
	(1.22)	(4.61)***
Manufacturing VA in foreign exports of partners	1.139	-4.094
	(1.94)*	(-7.06)***
BS VA in final demand of partners	-0.419	-4.556
	(-0.58)	(5.90)***
Manufacturing VA in final demand of partners	-0.455	3.775
	(-0.83)	(11.60)***
Public expenditure on education over GDP	0.097	-0.277
	(0.85)	(-1.80)*
R&D over GDP	0.374	-0.058
	(4.93)***	(-0.91)
Hourly wage of high skilled workers	-0.293	-0.159
	(-2.68)***	(-0.51)
Internet users per 100 people	0.084	-0.005
	(1.31)	(-0.05)
Count of provisions stimulating the liberalization	0.003	0.035
of trade in services	(0.8)	(2.97)***
Share of direct VA attributed to high skilled	0.017	0.347
labour returns	(0.14)	(1.99)**
Capital labour ratio	0.109	0.082
	(1.83)*	(2.03)**
Constant	-4.834	0.069
	(-3.19)***	(0.02)
Observations	110	71
Number of coun	13	9
Robust z statistics in parentheses		
* significant at 10%; ** significant at 5%; *** significant at 1%		

Engagement in Manufacturing GVCs

DmanufVAE identifies the domestic manufacturing value added directly and indirectly embodied in exports. It is calculated from the VAE matrix (Equation 1) by taking the sum of the domestic rows of the manufacturing sector.

$$DmanufVAE_n = \sum_j \sum_i VAE_{n,c,i,j} \;\; if \;\; n \neq c \; and \; i = manuf \qquad \text{(a1)}$$

Domestic Hirschman-Linder Linkages for manufacturing

The manufacturing Hirschman-Linder linkages (manufDDEM) is calculated by taking the sum of the domestic element of the manufacturing rows of the VADFD matrix:

$$manufDDEM_n = \sum_j \sum_i VAE_{n,c,i,j} \;\; if \;\; n = c \; and \; i = manuf \qquad \text{(a2)}$$

$$manufDDEMmanuf_n = \sum_j \sum_i VAE_{n,c,i,j} \;\; if \;\; n = c \; and \; i = j = manuf \qquad \text{(a3)}$$

Domestic Hirschman-Linder Linkages of distance weighted trade partners

$$\text{manufDDEM\_par}_n = \sum_n manufDDEM_n . \frac{distance_{n,c}}{\sum_n distance_{n,c}} \; if \; n \neq c \qquad \text{(a3)}$$

Potential international spillover or GVC linkages

$$\text{DmanufVAFE\_par}_n = \sum_n \text{DmanufVAE\_par}_n . \frac{distance_{n,c}}{\sum_n distance_{n,c}} \; if \; n \neq c \qquad \text{(a4)}$$